DOCUMENT RESUME

ED 241 268 SE 043 918

AUTHOR Duggan, Donald D.
TITLE The Federal Role in Energy Education in the U.S.A.
INSTITUTION Department of Energy, Washington, D.C. Office of Energy Research.
PUB DATE 83
NOTE 13p.; In: Veziroglu, T. N., Ed. Alternative Energy Sources V. Part F: Energy Economics/Planning/Education. Amsterdam, Elsevier Science Publishers B.V., 1983, p447-458. Small print may affect reproducibility.
PUB TYPE Historical Materials (060) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Conservation Education; *Curriculum Development; *Energy Conservation; Engineering Education; Environmental Education; *Federal Programs; *Government Role; Instructional Materials; Material Development; *Program Effectiveness; *Science Education; Training
IDENTIFIERS Department of Energy; *Energy Education; National Science Foundation

ABSTRACT

The federal government's role in energy education in the United States over the past 35 years is discussed, focusing on four major areas: (1) training at all academic levels; (2) instructional materials and their development; (3) conceptual foundations of energy education materials; and (4) research and evaluation studies on the effectiveness of the federal government's attempts at energy education. Among the programs reviewed are those sponsored by the Atomic Energy Commission (AEC), Department of Energy (DOE), and the National Science Foundation. Also reviewed is the government response to the Arab-imposed oil embargo, formation of the Federal Energy Office (FEA), absorption of the FEA and AEC into the Energy Research and Development Administration, and the eventual establishment of the Department of Energy. In addition, government-sponsored efforts at articulating a coherent set of ideas related to energy education are reviewed. These efforts are reflected in such reports as "Fundamentals of Environmental Education," "Energy Education Workshop Handbook," and "A Conceptual Framework for Energy Education, K-12." The latter is a detailed outline for curriculum specialists, textbook writers, and producers of other forms of energy curriculum materials. The scope and conclusions of several studies of federal energy education programs concludes this document. (JM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED241268

Alternative Energy Sources V. Part F: Energy Economics/Planning/Education, edited by T.N. Veziroglu
Elsevier Science Publishers B.V., Amsterdam – Printed in The Netherlands, 1983

THE FEDERAL ROLE IN ENERGY EDUCATION IN THE U.S.A.

Donald D. Duggan
Office of Energy Research
U.S. Department of Energy
Washington, D.C. 20585, U.S.A.

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Donald D. Duggan
Dept. of Energy
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

ABSTRACT

The purpose of this paper is to describe the part that the Federal government has played over the past 35 years or so in the field of energy education in the United States, and to describe the evaluations that have been conducted of that effort. At this time of diminishing Federal involvement in both energy and education, such an historical summary may be both useful and instructive for those who wish to continue the effort on a local basis.

In this paper, discussion of energy education will be limited to the realm of formal training. It shall not include the more general "energy education" efforts such as TV, news releases, exhibits, etc. which should be called public awareness more properly than education. It will include a discussion of the Federal efforts at various academic levels, from elementary school through high school, vocational school, college, and university levels.

The Federal government has been involved in energy education since at least the late 1940's. The earliest government-supported energy education program was conducted by the Atomic Energy Commission (AEC), and focused, of course, on the peaceful uses of atomic energy. Programs included graduate fellowships and traineeships in nuclear science, engineering, health physics, industrial hygiene and industrial medicine, faculty institutes and workshops for college faculty and secondary school teachers, and the production and distribution of large numbers of booklets and pamphlets on atomic energy and its applications.

In response to the Arab-imposed oil embargo of 1973-74, new Federal agencies were established to deal with the "energy crisis." First was the Federal Energy Office (FEO), which became the Federal Energy Administration (FEA). This agency was primarily a policy and regulatory agency, although it did conduct some R&D as well. Shortly after FEA was founded, an attempt was made to link all the Federal energy R&D efforts together; the AEC was absorbed into a new research agency, the Energy Research and Development Administration (ERDA), which existed for a few years in tandem with (and sometimes in competition with) the FEA. In 1977, both agencies, as well as the Federal Power Commission, were merged into a new Cabinet level agency, the Department of Energy (DOE). In 1982, the Administration introduced legislation to abolish the Department of Energy, and to transfer most of its R&D functions to the Department of Commerce.

In addition to those agencies whose legislated mission dealt with energy specifically, there were also occasional energy-related programs sponsored by agencies with different primary responsibilities, e.g., the Department of

SE043918

Education and the National Science Foundation. Interagency coordination and cooperation in such cases was often a goal more desired than attained. An additional complicating factor on the Federal scene, of course, has been the rapidly changing set of players (agencies), and sometimes wide swings in energy policy.

In general, there have been two main areas in which the Federal government has played a major role in energy education: training and materials development.

1. TRAINING

The National Laboratories, which have played an integral part in the government's energy research for decades, also had an important role in federally sponsored energy education. As early as 1947, under the AEC, both university faculty and graduate students began to be involved in ongoing research programs at these laboratories. This interaction was not formalized into a directly funded program, however, until 1964, when it was established as the University/Laboratory Cooperative Program. The opportunity for faculty and students to become involved in the cutting edge of energy research has been invaluable to the institutions involved, and has been a great asset to the individuals as well. Programs include faculty research participation, student research participation (primarily summer), thesis research, student/faculty seminars and workshops, conferences, visiting lecturers, and return faculty research visits. The scope of this program can be indicated by the fact that in addition to the research-related activities, which reach something in excess of 1,000 students and faculty each year, there are several instructional programs that involve nearly 1,000 additional students and faculty annually. The content of the instruction and enrichment activities in the University/Laboratory Cooperative Program varies with the research going on at the individual laboratories. This program is still an ongoing activity of DOE.

In 1948, the AEC established a Graduate Fellowship Program, which provided financial assistance to graduate students in the fields of nuclear science and engineering, health physics, and industrial hygene. The program ended in 1973. In the 25 years of its existence, a total of $25 million was spent to train 3,320 graduate students in these fields.

Between 1958 and the late 1960's, in conjunction with the National Science Foundation, the AEC conducted a series of Summer Institutes for high school and college faculty, in such areas as radiobiology, nuclear science and engineering, reactor technology, and radioisotope application.

A program of Graduate Traineeships was also established by the AEC, in 1965. This program was initially designed to provide support for graduate students in nuclear science and engineering. However, as AEC was absorbed into ERDA, and then into DOE, and as the energy missions of these agencies expanded, so too the fields of graduate traineeships expanded, to include at one time or another radiation protection, environmental science and engineering, fusion, geothermal, solar, conservation and even the social sciences. More recently, the program has focused on support for graduate engineering students. Since its inception, nearly $10 million has been spent for more than 1,500 graduate traineeships. This program has been funded through FY 1983 by DOE.

The AEC was also mindful of the training requirements of technicians and skilled workers needed in the nuclear industry. Working with various agencies since 1966, AEC, ERDA and DOE have supported a highly targeted Training and Technology Program, which has provided technical training in welding,

instrumentation, etc. in DOE's Oak Ridge facilities for well over 4,000 men and women.

In 1973 the AEC began a program then called the Pre-Freshman and Cooperative Education for Minorities in Engineering Program (Preface), a program later called more simply the Pre-Freshman Engineering Program (PREP). These activies were designed to give minority students and women an opportunity and an incentive to approach the field of engineering. Special enrichment activities are conducted for minority and female students as early as junior high school, involving them in studies which make engineering a realistic and attractive career option. This activity is funded through in FY 1983.

The Faculty Development Program was intitiated in 1971 under the AEC, and continued under ERDA and DOE until 1982. The original intent of this program was to inform high school teachers of the role of nuclear energy in the production of electrical power. As ERDA broadened the mission of AEC, the subject matter of the summer faculty workshops and institutes was accordingly broadened to include a wide variety of energy topics, such as solar, geothermal, fossil, nuclear, conservation, and energy economics. The National Endowment for the Humanities participated for a few years in co-funding projects which brought into consideration dimensions of human values affecting and affected by current energy issues. During the life of the program, $9 million was spent in hundreds of our Nation's colleges and universities, and the program reached over 16,000 teachers. The Administration has not requested funds for this program in FY 1983.

Several other technology-specific training programs have also been supported by DOE. In 1977, eight universities were selected to house solar meteorology training centers. A specialized program in fusion engineering is supporting a small number of graduate engineering students through fellowships. Training programs for solar installers were created for contractors, correctional institutions, and low income communities. A number of training programs were also conducted to train farmers and others in techniques of small-scale alcohol fuel production.

2. TEACHING MATERIALS

In a continuing effort to assist teachers to teach about energy more easily, more effectively and more correctly, the DOE and its predecessor agencies developed and distributed a wide range of printed materials for schools at all levels. Beginning in 1962, the AEC inaugurated the publication of a large number of booklets for schools, which later were also widely distributed to the general public. Between 1962 and 1974, the AEC distributed over 12 million copies of the "Understanding the Atom" series, 84 booklets relating to atomic energy, as well as 360,000 copies of 6 posters. Another 6.5 million booklets and pamphlets were distributed by ERDA.

Two major curriculum development programs were initiated in ERDA, and continued in DOE. The "Project for an Energy Enriched Curriculum" was developed by the National Science Teachers Association (NSTA), and by the end of FY 1982 nearly 2 million teacher factsheets on energy technologies, and 1.5 million packets of 15 lesson plans for grades K - 12 had been distributed. The Project for an Energy Enriched Curriculum was an attempt to infuse energy-related information into already existing courses through an interdisciplinary approach. A second major program, "Science Activities in Energy," was developed by Oak Ridge Associated Universities, and took a more hands-on, disciplinary approach. In this program, discovery-type activities were developed for junior and senior

high school science classes, to demonstrate the scientific principles relating to energy production, distribution, conservation and consumption. Since the inception of that program, over one million sets of lesson plans have been distributed to teachers. Two solar curriculum projects were also initiated, at SUNY/Albany, and at USC, with materials developed for elementary and secondary levels. Between 1977 and 1982, DOE also published a large number of individual teaching packets on various energy topics, from geothermal energy to energy efficient home appliances. The Administration has not requested any funds in FY 1983 for continuation of the DOE curriculum development program.

The National Science Foundation funded MIT in 1975 to develop "Project PROCEED" (Program for Continuing Engineering Education) which developed a number of energy-related training modules for practicing engineers. The Department of Education, primarily through its Office of Vocational and Adult Education, sponsored several curriculum projects to educate workers about energy careers. A Nuclear Technology Series of two-year postsecondary curricula were developed for five different kinds of nuclear power plant technicians by the Technical Education Research Center SW, of Waco, Texas. "Physics for Technicians" was a series of high school or postsecondary physics modules especially for energy-related technicians. "Energy Conservation and Use Technicians" was a two-year postsecondary program developed by the Center for Occupational Research and Development, Waco, Texas. "Energy Conservation Vocational Instruction Modules" were designed to infuse conservation concepts into vocational instructional materials in seven occupational fields. "Project Effect" was also a two-year postsecondary program, for Energy Conservation Technicians, developed by Indiana University at South Bend.

3. CONCEPTUAL FOUNDATIONS

The content of the teaching materials and other items produced for the various agencies of the Federal government generally reflected both the mission of the particular agency and office which were responsible for the product, and also the direction of national energy policy at a specific time. Thus material developed by the AEC, for example, focused on atomic energy, and helped explain and promote its peaceful uses. Material sponsored by DOE's Office of Solar Energy dealt exclusively with that technology, and so on. At times, this narrowness of focus led to bias in favor of a particular technology.

The first government-wide attempt to articulate a coherent set of ideas relating to energy education was a paper developed by the Federal Interagency Committee on Education's Subcommittee on Environmental Education entitled Fundamentals of Environmental Education, (1976, US Department of Health, Education and Welfare/Education Division). That report was structured in four sections:

- o the natural principles about the operation of all Earth's ecosystems, manmade and natural;
- o fundamentals about the functioning of the human species in the Earth's ecosystems;
- o processes, methods and tools for using these fundamentals for harmonizing human activities in Earth's ecosystems;
- o examples of broad questions for individuals and multinational groups alike to solve.

While this framework focused on environmental education, energy was clearly and explicitly included. At a later date, the same Federal Interagency Committee on Education requested the Department of Energy to prepare a similar study of the concepts appropriately included in comprehensive energy education programs.

The Department of Energy first asked the National Science Teachers Association, as part of its Project for an Energy Enriched Curriculum, to articulate what it felt should be included in such a comprehensive energy education program at the elementary and secondary school levels. The NSTA outline (for that is really all it purported to be) was first published in the Energy Education Workshop Handbook published in 1978 by DOE. It was entitled "Major Concepts for Energy/Environment/Economics Education." Clearly not intended just for science teachers, the content was broken down into six general areas:

- o energy as a basic need (including forms and states of energy, sources, measurements, forms of energy conversion and flows);
- o finiteness of energy usefulness (laws of thermodynamics, limits to resources, demand patterns);
- o environmental effects (of extraction, transportation, distribution, consumption);
- o societal effects (economic, lifestyle, employment, international inequities);
- o energy policy (various roles, cost/benefit considerations, conservation),and
- o energy futures (mid and long term, as well as socio/economic/ environmental futures).

These major concepts were employed in the design of the materials in the NSTA Project for an Energy Enriched Curriculum, and are reflected in the 15 packets already published in that series, as well as the 25 or so packets which have not been published by DOE.

In an article published in 1978 ("Energy Education and the Three C's," Science and Children) I characterized the general context of energy education as including citizen education, career education, and consumer education (the "Three C's"). Citizen education in energy "ought to be as broad as the energy problem itself. The study of energy should pervade the entire spectrum of education, and involve all grade levels. Energy education is relevant not only to the sciences and social sciences, but to all areas of the curriculum. Energy education needs to be firmly based in the physical sciences, with a clear understanding, for example, of the first two laws of thermodynamics. But neither the scientist nor the general public can afford to be ignorant of the social, environmental and economic factors involved in energy production, use, conservation, and public policy involved." (Op. cit. p.8.)

Career education, as it relates to energy, will help prepare some students for energy related careers, and all students for careers affected by the changing energy situation. Consumer education, of course, involves many purchasing and lifestyle choices.

In 1982, DOE published A Conceptual Framework for Energy Education, K-12, which was produced by Enterprise for Education, Inc. This more detailed outline "is intended as a tool for curriculum specialists, writers of textbooks, and pro-

ducers of other forms of curriculum material. It is not meant for the classroom teacher; still less for use by students. In funding the preparation of this report, it was explicitly not the intention of the Department of Energy to suggest that there is one best energy education framework, or to urge the adoption of any part of the contents by any educational body." (Cp. cit. p. 1.) The concepts are broken down into 13 headings:

- o conversion and measurement of energy;
- o energy flow in the biosphere;
- o human use of energy;
- o energy history of the United States;
- o energy from fossil fuels;
- o energy from nuclear reactions;
- o energy from solar technologies;
- o electricity as an energy carrier;
- o economic and financial aspects of energy use;
- o ethical issues in energy use;
- o conservation of energy;
- o shelter-related conservation, and
- o transportation conservation.

In addition to a detailed elaboration of these 13 basic concepts in energy education, Enterprise for Education went a step farther. Their study provided an in-depth look at typical K-12 science and social studies texts and curricula, and made an attempt to correlate the basic concepts by grade and by discipline.

It is my hope and expectation that A Conceptual Framework for Energy Education, K-12 will be a very useful and influential document for curriculum planners and textbook authors, editors and publishers. It needs to be discussed, criticized and modified by input from educators and scientists interested in energy education. I hope that you will be part of that process.

4. RESEARCH AND EVALUATION

How effective have been the Federal government's attempts at energy education? How have they been perceived by researchers, by teachers and by students? How deeply have they penetrated into our Nation's schools? And what has been their effect on the understanding, attitudes and behavior of teachers, students, and the general public?

Not all of these questions have been answered, or even asked by the Federal government. However, some research has been done, and I will make an attempt to outline in chronological order the scope and conclusions of the few extant studies of Federal energy education programs.

"An Evaluation of ERDA's Faculty Development Workshops in Energy" was a

1976 student thesis by David J. Thibodeau, Jr. and Wesley P. Wheeler, of Worchester Polytechnic Institute. The students conducted a follow-up survey of participants in 1974 and 1975 Faculty Development workshops. (The 1974 workshops were conducted by AEC, the 1975 workshops by the newly formed ERDA.) They found that the respondents were generally satisfied, and felt that they had benefited by the workshops. Criticism was voiced, however, of the nuclear emphasis of the workshops, in the light of the broader mission of ERDA.

"Content Analysis and Interpretation of Five Regional Hearings Conducted by Educational Testing Service to Determine Current Status and Future Needs In-School Energy Education" was funded by the Federal Energy Administration in 1976. It reported on needs assessment hearings held in Atlanta, Boston, Chicago, Dallas and Portland. Major conclusions were:

- o the need to develop energy awareness;
- o the need to develop direction in energy education curriculum, with specified goals from which materials might be developed;
- o energy education should be taught as an integrated topic, with interrelated content;
- o an interdisciplinary approach is recommended;
- o there was a lack of useful classroom material and structured programs;
- o funding is needed, and
- o teacher training is needed.

"A Survey of PreCollege Energy Education Curricula at the State Level" was conducted by the Energy Institute of the University of Houston in 1977. While this study examines state rather than Federal programs, it is included here because it demonstrates the context in which the Federal programs were operating. All 50 states were surveyed, with 49 responding. Twenty state-level curriculum programs were received and evaluated. Most were criticised as not being true curriculum materials, since they were lacking in stated or implied curricular organization. Few of the materials evaluated included sufficient real data or background information for meaningful activities. The teachers were expected to research and provide the factual data, with no guidance. "There are varying levels of technical sophistication in the presentation of the materials ranging from oversimplification to inundation with complex presentations of multiple and range graphs and alternate scenarios for the future" (p.7).

"Energy Knowledge and Attitudes, A National Assessment of Energy Awareness Among Young Adults" is cited here also to place the Federal effort in context. This seminal study, conducted by the National Assessment of Educational Progress (ECS Report No. 08-E-01,1978) is the first, and to date the only study, of what people across this Nation actually know about energy. A stratified national sample of 1,300 young adults ages 26-35 was interviewed during the summer of 1977 not only on their attitudes on various energy issues, but (more importantly, I think) what they actually knew about a number of basic energy facts and issues. The conclusions of this study demonstrated an alarming state of ignorance. Although the study was made during a period of intense national debate about energy (the President had just submitted his first National Energy Plan to Congress, and the Administration was engaged in a significant campaign

to promote acceptance of these policies), and although the sample of young adults studied is often considered the group most aware of current issues, still the number and seriousness of factual errors and misconceptions lead one to the conclusion that the American public lacked sufficient knowledge about energy to make truly informed decisions. For example, less than half knew that petroleum provides the largest percentage of energy consumed in the United States. And only 14% knew that coal is the primary energy source used to produce the largest portion of the Nation's electrical energy. (The largest group thought hydro power was our main source of electricity!) Interestingly enough, 95% believed that topics like basic energy knowledge, energy problems, and the future of energy should definitely be an important part of every school's curriculum.

"The Status of State Energy Education Policy" also looked at state, rather than Federal efforts, this time from the state policy perspective. The study was conducted by the Education Commission of the States for the Department of Energy, and published in 1979 (HCP/U6241-01). A survey was conducted in May 1978 of all state energy offices, education offices, governor's offices and state legislatures, to determine the nature and extent of energy education policy and practices on the state-wide level. With responses from 70% of the agencies surveyed, the study found:

- o a major lack of communication and cooperation among agencies within states;
- o most states' elementary/secondary energy education programs were funded through state energy offices, largely with Federal funds (only California and Pennsylvania reported state-appropriated funds for energy education), and
- o the states did not report a lack of curriculum materials.

"The Laboratory Cooperative Program: An Assessment" was conducted by Penta International Inc. for DOE in 1979. The study pointed out that the Laboratory Cooperative Program was originally established to transfer fundamental science and nuclear-related technical information to the academic community, and that gradually (in ERDA and DOE) its scope broadened. The program was criticised for a lack of cohesiveness and a diversity of opinion as to its primary purpose. The program was, the report stated, widely accepted as beneficial, both to the laboratories (and thus the government), and to the participants, although these benefits are difficult to measure and impossible to quantify.

"The Pre-Freshman and Cooperative Education for Minorities in Engineering Program: 1979 Evaluation" was conducted for DOE by Oak Ridge Associated Universities. The report characterized the program as having a moderately high level of success in increasing the retention of interested qualifiable and qualified high school graduates in college engineering programs. Evaluation of this program was rendered difficult because of the wide variety of programs conducted under the aegis of PREFACE/PREP.

"Review and Evaluation of DOE Energy Education Curriculum Materials" (DOE/TID/6037-1) was conducted for DOE by Battelle Columbus Laboratories in 1979. The major findings of the study were:

- o teacher users of DOE energy education materials generally provided a favorable evaluation of the materials in terms of relevance to students, technical and reading levels, ease of use with existing curriculum, and impact on student awareness and

understanding of the present energy situation;

- of the teachers reporting that they had received the DOE materials, about two-thirds actually used them in their classes, and

- DOE curriculum materials appear to have limited use in our Nation's schools, apparently because significant numbers of teachers do not know the materials exist.

"An Analysis and Evaluation of the NSTA Energy Education Materials Produced by Project PEEC" was a 1979 graduate thesis by Warren James Kooi at West Virginia University. Kooi evaluated a total of 21 units developed by NSTA's Project for an Energy Enriched Curriculum (PEEC). Thus some of the units analyzed are still unpublished. He criticised a number of the units for discrepencies in reading level for the assigned grades. He also said, "The PEEC materials addressed all identified energy content areas, but not enough exposure was given to the areas of energy conservation, physical laws, and energy strategies. While the materials dealing with future energy issues were found to be somewhat biased toward centralized energy systems and more biased toward the conservationist point of view, the materials were not consistently biased toward any particular energy future philosophy." (P. 76) This comment is interesting in the light of a later criticism from a Congressional committee report.

"Evaluation of the Energy Extension Service Pilot Program, Report to Congress" (DOE/CS-0074, 1979) is included here because it contains a unique attempt to evaluate an energy education program not only qualitatively, but quantitatively, i.e. in terms of BTU's and dollars saved. When the Energy Extension Service (EES) was established by Congress, there was first a pilot program in ten states, which was extensively evaluated before proceeding with a national program. The purpose of the EES was to promote energy conservation by providing personalized services to individuals and small businesses. The states were given wide latitude in how they would carry out this mandate, and one of the pilot states, Michigan, included a school component, which they described as their Youth Project. Services provided included teacher training workshops and one-to-one teacher assistance, free curriculum materials, and follow-up consultation and testing. The evaluation indicated that qualitatively, the direct teacher assistance (teacher training workshops) were found to have superior effectiveness, i.e. to have improved student and family attitudes and actions relative to energy conservation, when compared to school-wide assembly programs, student conservation organizations, or attempts to organize school-wide energy committees. Quantitatively, 616 teachers and 30,030 students were served. Seventy-four percent of the teachers and 67% of the students rated the service as "very valuable." The project resulted in 4,030 student conservation actions, and 1,949 parent conservation actions. "BTU and Energy $ Savings (over or above average for non-served population)" were characterized as follows:

BTU Savings	Associated Savings	Program Costs	Energy $ Return On Each Tax Dollar Investment
98,510 to 473,217 x 10(6)	$620,778 to $1,416,652	$290,043	$2.14 to $4.88

For comparison, the Energy $ Return on Each Tax Dollar Investment for the total Michigan effort was $1.13 to $2.8[illegible]. The educational program thus had by far the highest return of any of the programs undertaken by the Michigan Energy Extension Service pilot program.

"The DOE Faculty Development Program: An Evaluation" was conducted in 1980 by Oak Ridge Associated Universities for DOE. Separate follow-up surveys of 1978 and 1979 workshop participants were conducted. The 1979 participants were asked to describe the quality of the workshops and their intent to introduce energy concepts into their classrooms. The major findings for this group were:

- o participants generally rated the workshops very highly on five measures of quality: content, usefullness, appropriateness of the level of presentation, opportunity to exchange information, and lack of bias, and
- o participants reported that they intended to use the knowledge and skills gained from the workshops in a variety of ways in their classrooms.

A sample of participants in the 1978 workshops, and a national sample of high school science teachers used as a control group, were asked questions aimed at determining the effects of the program. Major findings include the following:

- o a substantially higher percentage of participants (88%) than comparison teachers (71%) had introduced energy materials or units into their classrooms since the workshops were held;
- o three-fourths of the participating teachers shared the energy knowledge they gained with families and fellow teachers, and
- o 18% passed this knowledge to community groups, 33% started conservation projects in their homes, and 25% started such projects in their schools.

"The Department of Energy's Public Information Programs: Major Changes Needed" was the title of a report prepared by the staff of the Subcommittee on Energy Research and Production of the House Committee on Science and Technology. This report, which was dated December 1980, was highly critical of the public information and education programs of DOE. In his transmittal letter, Congressman Mike McCormack, then Chairman of the Subcommittee, wrote "The report identifies a general lack of balance and objectivity in the DOE's educational programs and concludes that the programs heavily emphasize renewable forms of energy, especially solar energy, and largely ignore central station energy sources, particularly nuclear energy or depict them in an unfavorable light. While renewable energy forms are an important resource which should be developed, the DOE has fostered the erroneous and dangerous public perception that they can play a major role in meeting national energy requirements, and that further development of central generating stations is unnecessary and undesirable." Some of the Findings and Recommendations of the report included:

- o "Many of the Department's programs in public information and education foster the erroneous and potentially dangerous public perception that decentralized, renewable energy, can play a major role through the rest of this century in meeting national energy requirements, and that further development of centralized energy and in particular nuclear energy is unnecessary and undesirable."
- o "The Department of Energy should replace its programs in public education and information with new programs that reflect an objective, balanced and realistic view toward

energy resources and the problems and opportunities in meeting the Nation's requirements for energy. The Department should suspend most of its existing public educational activities until new programs can be developed."

- "The Department of Energy, through new public educational and informational programs, should fulfill its statutory obligations by turning away from highlighting the negative and controversial aspects of central station energy sources including nuclear power and toward publishing the facts on these energy forms, as well as undertaking education programs directed at increasing public understanding and allaying unrealistic fears associated with nuclear energy. An even-handed treatment should be applied to all energy sources."

"Analysis of Past Activities of the Office of Consumer Affairs' Education Division and Proposed Future Modifications" was the title of an internal study by the Office of Program Analysis of the Office of Energy Research, DOE. (In early 1981 the Education Division was transferred from the Office of Consumer Affairs, DOE, to the Office of Energy Research. This study was to help determine the future direction of its programs.) The report presented several options to DOE management, and recommended the following:

- adopt a dual purpose (general education and science careers) program centered on the junior/senior high school audience.

The most recent attempt to measure the impact of energy education programs in this country (all programs, not just Federally sponsored ones) is the "Survey of the Current Status of Energy Education," conducted by the National Science Teachers Association for DOE at the end of the 1981-82 school year. This survey is an attempt to identify the extent of penetration of energy education into the Nation's elementary and secondary schools, to gather information on how energy is most often taught, and to identify factors which either facilitate or prevent energy education from happening.

Seven thousand educators were surveyed: 1,000 randomly selected from each of the following categories: elementary school principals, secondary school principals, high school teachers of science, social studies, mathematics and home economics, and elementary school teachers. With a 22% general response rate, the survey indicates that energy education is quite widespread. In response to the question whether they taught energy in their classrooms this school year, teachers answered affirmatively in the following proportions:

science teachers	68%
social studies teachers	53%
mathematics teachers	18%
home economics teachers	64%
elementary school teachers	58%

The median amount of time devoted to energy education is a surprisingly high eight class hours. Energy conservation was the topic most often included (90%), followed by production technologies (conventional 63% and renewable 59%). Energy/environmental interaction was taught by 54% and energy/economics by 44% of the teachers responding.

Teachers were extremely critical of how commercial textbooks handled energy topics. Texts were rated as follows:

	Elementary Teachers	Secondary Teachers
Excellent	2.8%	1.2%
Satisfactory	14.0%	15.7%
Inadequate	65.4%	64.0%
No Opinion	17.9%	18.9%

Perhaps because of this dissatisfaction, most teachers (62%) produced their own materials on energy, while 48% used industry-sponsored materials, and 47% used textbooks to teach about energy. (Note that these figures overlap.) Of those teachers who did not teach about energy at all, 54% felt they would probably do so if good free or inexpensive materials were available.

School-wide energy education activities are fairly common. Thirty-four percent of principals reported science and/or energy fairs, 30% had energy-related field trips, 16% had energy school assemblies, 15% had teacher workshops, and 5% participated in National Energy Education Day activities.

Of those teachers who reported that they did not include energy in their curricula, the largest group (58%) said that they did not feel it was part of their curricular responsibility, but that they would do so if required. On the other hand, 70% of the teachers who do teach about energy do so primarily out of personal conviction rather than curricular requirement.

Teachers felt little encouragement from state, district onistrations. Sixty-eight percent of elementary teachers and 83% of secondary teachers perceived little or no emphasis on energy from principals. Yet over 90% of teachers and principals alike reported that they felt that energy education should be included in school curricula. (A similar response was obtained from the general public when surveyed by the National Assessment of Educational Progress in their 1977 study, "Energy Knowledge and Attitudes.")

Finally, the rising cost of energy appears to be having considerable impact on the resources available for educational programs in schools. Principals reported this adverse impact as follows:

	Elementary	Secondary
Significant impact	38%	36%
Minor impact	41%	45%
Little or no impact	19%	16%

A significantly higher impact was reported for suburban elementary schools and urban high schools, especially in larger schools and larger school districts.

5. POSTSCRIPT

In line with the Administration's desire to reduce federal expenditures and to transfer educational initiatives back to state and local jurisdictions, most federal energy education programs have been or are being terminated. For the Department of Energy, FY 1983 funds have been requested to continue only the University/Laboratory Cooperative Program and a few nuclear education activities. Development and dissemination of teaching materials, faculty training, support for energy-related graduate students, and evaluation and research in energy education fields must now be taken up by state and local governments, with the assistance wherever possible of the private sector, if this effort is to continue.